

THE GENUS CHLOROPHYLLUM (LEPIOTACEAE)  
IN CALIFORNIA

WALTER J. SUNDBERG

Department of Botany, University of California, Davis 95616

*Chorophyllum molybdites* (Meyer ex Fr.) Masee, the only species in the genus, was first reported from Southern California by Smith (1936), but without an accompanying description. While conducting a regional taxonomic study of *Lepiota* S. F. Gray and related genera (Sundberg, 1967), I verified the occurrence of *C. molybdites* in Southern California. Subsequent field work and herbarium studies indicated that its range extended much further north than Los Angeles, the northern limit reported by Smith (1936). Since *C. molybdites* is poisonous to some individuals (Singer, 1948; 1962; Smith, 1954), and often appears in cultivated areas such as lawns and gardens, it seems important to report on the characteristics and extended geographical distribution of California material.

A detailed morphological and anatomical description is included because few exist in the literature and published descriptions of California specimens are non-existent. Colors in quotation marks are those of Ridgway (1912). Where Ridgway's terminology may be unfamiliar to those lacking access to his color standard, approximations of his colors are included in general terms. Thirty-four collections were examined and deposited in either the herbaria of San Francisco State College or University of California, Berkeley. The distribution map (fig. 2) is based upon personal observations and data from herbarium specimens.

CHLOROPHYLLUM MOLYBDITES (Meyer ex Fr.) Masee, Bull. Misc. Inform. 1898: 136.1898.

Pileus 4.5–15.5 cm broad, ovoid to obtuse when young and unopened, becoming convex to broadly convex upon opening, finally plano-convex to uplifted in age, disc sometimes distinctly raised following expansion; margin incurved prior to rupture of the partial veil, remaining incurved upon opening, then becoming decurved, infrequently plane in age, finely lacerate at first, becoming rimulose to rimose, finally splitting deeply, often faintly striate (more obvious in age); surface moist but not viscid when young, becoming dry; cuticle continuous in the young button stage, during enlargement remaining continuous on the disc but becoming concentrically to irregularly diffracted and forming flattened to uplifted scales which often rub off easily toward the margin, infrequently splitting radially, the disc becoming diffracted scaly to areolate scaly in age with the scales composed in part of the flesh; exposed flesh (the remainder of the pileus surface in later stages) appearing appressed fibrillose to appressed fibrillose scaly, frequently shaggy fibrillose scaly to minutely squarrose scaly toward the margin (especially when young), the scales easily rubbing off and formed primarily by aggregation of the upper layers of radially arranged flesh fibrils, rarely with small amounts of cuticle at the tips; cuticle color variable in young unopened carpophores, reddish brown ("russet" to "rood's brown" to "liver brown" to "warm sepia") to brown ("sayal brown" to "bister"), often variegated and spotted with pale to dark buff shades ("light ochraceous-buff" to "antimony yellow" or "pale pinkish buff" to "cinnamon-buff"),



FIG. 1. *Chlorophyllum molybdites*,  $\times \frac{1}{5}$ , Sundberg 1228.

occasionally spotted dull pinkish vinaceous ("light cinnamon-drab") to pinkish brown ("fawn color") to blackish purple ("dark livid brown" to "warm blackish brown"); disc and cuticular scales often assuming somewhat different shades of reddish brown ("natal brown") to "vandyke brown" to "argus brown" or brown ("brussels brown" to "prout's brown" to "cinnamon-brown" to "tawny-olive") to becoming pinkish brown ("wood brown" to rarely "avellaneous") with age; surface flesh white at first, rarely spotted pale pinkish ("pale cinnamon-pink") to dark pinkish vinaceous ("brownish vinaceous") in older but unopened buttons, sometimes with pinkish vinaceous ("light grayish vinaceous" to "light russet-vinaceous" or "light cinnamon-drab" to "cinnamon-drab") tinges near the margin, becoming brownish pink ("vinaceous-buff") to pinkish brown ("wood brown") to light pinkish gray (near "light drab") in age, usually unchanging or darkening slightly on bruising, rarely staining "cinnamon" at first, then pale reddish brown ("cacao brown") and finally becoming brown ("verona brown"); tips of scales composed of flesh becoming brown (dark "wood brown" to "snuff brown" to "saccardo's umber") in age. Flesh (2-) 5-13 mm thick at the disc, soft but solid; white to off-white ("tilleul buff") to tinged pinkish gray ("light drab"), cream to buff ("cream-buff" to "pinkish buff" to "cinnamon-buff") near the stipe apex and lamellae, staining pinkish ("buff-pink") to "light pinkish cinnamon" at first, then darkening to "cinnamon" to "orange-cinnamon," and finally becoming reddish brown ("vinaceous-russet" to "rood's brown" to "verona brown") when bruised, infrequently staining pale orange ("salmon color" to "orange-buff") or brown ("sayal brown" to "snuff brown") at first, then becoming reddish brown. Taste mild. Odor not distinctive.

Lamellae free, remote from the stipe even when young, sometimes forking and more rarely anastomosing near the stipe apex; close; 6-18 mm broad; fragile; thin at the margin, but moderately thick near the pileus flesh; white in mass when young, often even when first expanded, becoming pale green ("pale glaucous green" to "yellowish glaucous" to "water green") to gray-green ("court gray" to "tea green" to "celadine green") when mature, tinged near gold to olive-gold ("honey yellow" to "isabella color") where beginning to dry out naturally; margin entire and finely white fimbriate at first, becoming irregularly discontinuous and dark brown to almost black in age. Lamellulae in two to three tiers.

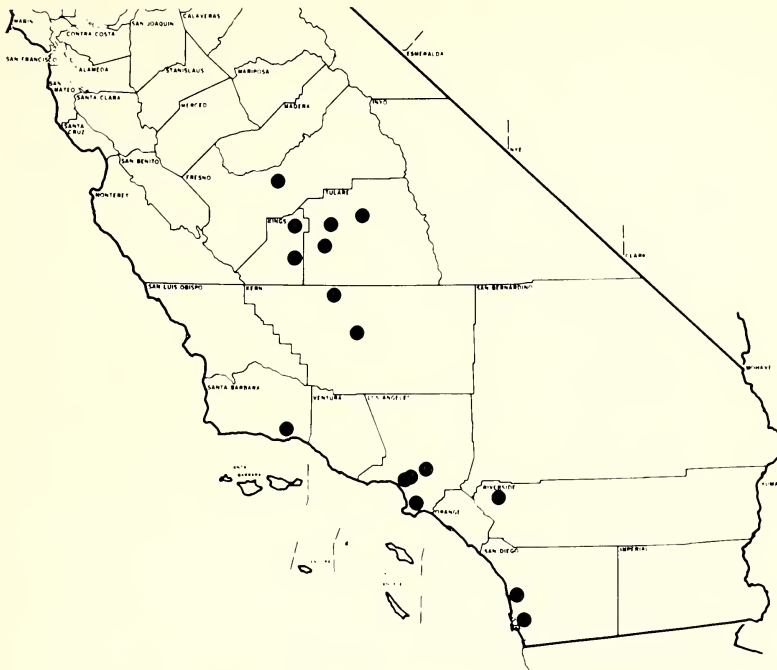


FIG. 2. Distribution of *Chlorophyllum molybdites* in California.

Stipe 5.7–12.0 cm long, 6–15 mm broad at the apex, equal to slightly enlarged below, rarely clavate; often but not always easily separable from the pileus; surface dry, silky to innately fibrillose throughout at first, sometimes appearing peronate-scaly above, areolate-splitting and shiny below in age, clothed at the base with a tightly appressed white mycelial growth; white to off-white (“tulleul buff”) to rarely pale buff (“pinkish buff”) above the annulus, sometimes streaked to tinted with pinkish vinaceous (“pale vinaceous-fawn” to “light russet vinaceous”) to dark pinkish brown (“fawn color” to “army brown”) to rarely dark pinkish gray (“benzo brown”) shades, often superficially green (“water green” to “gnaphalium green”) from spore deposits at maturity, staining buff (“cinnamon-buff”), then darkening to “cinnamon” to “vinaceous-cinnamon” when bruised; below the annulus white to near brownish pink (“avellaneous”) and sometimes spotted with pinkish vinaceous (“pale brownish vinaceous”) or purple-gray (“light brownish drab”) at first, becoming pale to dark pinkish brown (“wood brown” to “fawn color” to “natal brown”) to reddish brown (“cinnamon-brown” to “rood’s brown”) to “auburn” to “warm sepia”) in age, whitish fibrils forming an overtone giving the darker colors a streaked appearance; stuffed, becoming hollow; pith fibrils white to off-white (“tulleul buff”); cortex “tulleul buff” to infrequently brownish pink (“vinaceous-buff” to “avellaneous”), sometimes concolorous with the surface where adjacent to it, staining pale buff (“pinkish buff”), then buff (“cinnamon-buff” to “pinkish cinnamon”) to “cinnamon,” then pale orange (“orange-buff”) to “orange-cinnamon,” finally becoming pale to dark reddish brown (“vinaceous-tawny” to “russet” to “walnut brown” to “vandyke brown”) where bruised.

Annulus superior to infrequently median, attached and sleeved above, flaring below, typically immovable when fresh, often becoming free and movable on drying, thick and solid, complex and having three frequently indistinct flanges;



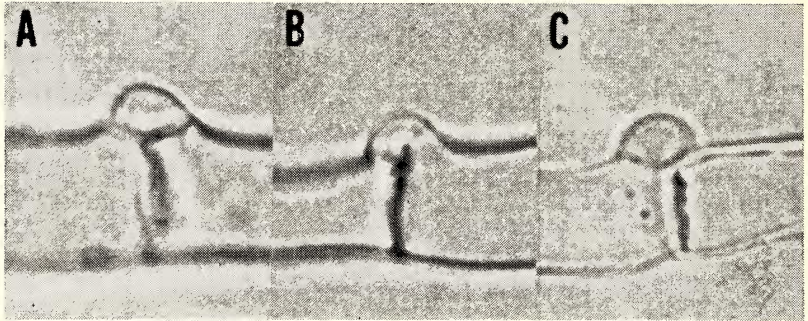


FIG. 3. Clamp connections from the pileus trama of *Chlorophyllum molybdites*: a, Sundberg 1251; b, c, Sundberg 1229. All approximately  $\times 2,100$ .

upper surface white and often spotted with pinkish vinaceous "pale vinaceous-fawn" to "light grayish vinaceous") to pinkish gray ("ecru drab") shades at first, becoming pinkish brown ("avellaneous" to "wood brown") in age, sometimes tinged green ("water green" to "gnaphalium green") from the spore deposit, undersurface brown ("snuff brown" to "prout's brown") to reddish brown (warm sepia") near the margin and white with infrequent pinkish vinaceous tinges elsewhere.

Spore deposit pale green ("pale glaucous green" to "deep lichen green" to "water green" to "corydalis green") to gray-green ("mineral gray" to "vetiver green" to "gnaphalium green" to "sage green" to "celadine green") to almost gray ("storm gray") when fresh, occasionally as light as "cream-buff," becoming slightly darker green ("tea green" to "andover green" to "lincoln green") on drying, fading in age to a shade of dark gold to brownish gold ("yellow ocher" to "mars yellow").

Spores (7.7-) 10.3-12.2 (-13.5)  $\times$  (6.3-) 7.7-9.0 (-10.9)  $\mu$ , ovoid to very short ellipsoid, apex truncate, infrequently at a slight angle, inequilateral in side view, smooth, hilar appendix present, apical pore present giving some a notched appearance, wall thick, aguttulate or uniguttulate, entire spore dark blue in cresyl blue, pale yellowish green to pale yellowish brown in KOH when viewed singly (color most obvious in wall), weakly to strongly dextrinoid (pale yellowish orange to reddish orange to reddish brown) when viewed singly in Melzer's reagent.

Basidia (24.2-) 29.4-44.8 (-61.5)  $\times$  9.0-12.9 (-14.1)  $\mu$ , mostly 4-spored, occasionally 3- or 2- or 1-spored but not notably different in size, clavate, some with narrow elongate bases, often granulose, hyaline to rarely tinged pale yellow to pale yellowish brown in KOH, yellowish to pale to deep yellowish orange in mass and hyaline to pale yellowish when viewed singly in Melzer's reagent.

Cheilocystidia (18.0-) 21.9-47.4 (-62.4)  $\times$  (9.5-) 10.3-25.5  $\mu$ , abundant, sometimes scattered in fascicles along the lamellae margin, arising as hyphal tips or branches, narrowly to broadly clavate to sphaeropedunculate to subsaccate, infrequently with angular to rostrate apices, rarely covered with an amorphous material, bases often narrow and elongate, walls thin to unevenly thickened and yellowish when viewed singly in KOH, hyaline to yellowish brown in mass and hyaline to pale yellowish to pale yellowish brown when viewed singly in KOH, concolorous in Melzer's reagent. Pleurocystidia absent.

Lamellae trama composed of loosely interwoven hyphae, hyaline in KOH, hyaline to pale yellowish in Melzer's reagent; oleiferous hyphae often present; subhymenium cellular, segments small, compact, concolorous with the trama proper.

Pileus trama composed of tightly or more often loosely interwoven hyphae, segments 5.1-15.4  $\mu$  wide, hypodermal segments usually shorter and broader than cuticular elements, sometimes swollen and enlarged, rarely almost globose, entire trama hyaline to infrequently yellowish to yellowish brown in KOH, pale yellow to pale yellowish orange in mass and hyaline to pale yellowish to pale yellowish orange

to rarely pale yellowish brown when viewed singly in Melzer's reagent (segments of the same hyphal strand may differ in color); oleiferous hyphae present, hyaline to pale yellowish to rarely pale yellowish green in KOH.

Cuticle scattered in patches due to diffraction caused by pileus expansion, composed of tightly and irregularly arranged more or less upright hypae and hyphal tips, appearing somewhat turf-like, longer hyphae or at least the apical portions frequently repent and forming a thin, often loosely arranged, appressed and interwoven layer above the upright elements; terminal segments usually not well differentiated, length extremely variable, (18-) 20.6-86.2 (-132.4)  $\times$  (2.6-) 3.8-9.0 (-15.8)  $\mu$ , often arising as hyphal branches, rarely ventricose to slightly enlarged above, very seldom clavate, apices usually rounded, infrequently tapered to mucronate or rostrate at the apex, walls irregularly flexuous, thin to unevenly thickened, especially in the upright segments, rarely encrusted, some appearing striated in KOH, infrequently with a fine sparse granular content; subterminal segments often with thickened walls; hyaline where thin to yellowish brown to rarely reddish brown where thick in mass and hyaline to pale yellowish to pale yellowish brown when viewed singly in KOH, pale yellowish orange to orange-brown to pale reddish brown in mass and hyaline to pale yellowish to pale to dark yellowish brown when viewed singly in Melzer's reagent.

Clamp connections always present in the pileus trama of both young and old specimens, often rare and never at every septum, seen at the base of some cheilocystidia in one collection, apparently lacking elsewhere.

A pale yellowish to pale yellowish brown pigment, which is soluble in water but not alcohol, diffuses from the tissue during sectioning preparation.

Habit and habitat: Scattered to gregarious in laws or more rarely in garden soils, usually arranged in fairy rings. July through September.

Specimens examined. Fresno Co.: *Sundberg*, 1217, 1220, 1222 1246-1248, *Thiers* 20742. Kern Co.: *Sundberg* 1236, 1237, *Thiers* 20740. Kings Co.: *Sundberg* 1230-1232, 1234. Los Angeles Co.: *Floyd* s. n., *Sloan*, in 1966, 1967, *Brubaker* s. n. Riverside Co.: *Smith* s. n. San Diego Co.: *McLean* s.n., *Miller* s. n. Santa Barbara Co.: *Walker* s. n. Tulare Co.: *Sundberg* 1225, 1227-1229, 1243-1245, 1249-1251, *Thiers* 20741.

#### DISCUSSION

*Chlorophyllum molybdites* differs from closely related taxa by its colored spores. It appears most similar to *Lepiota rachodes* (Vitt.) Quel., but lacks the palisade cuticle of pyriform cells found in the latter. Its summer and early fall fruiting habit is also distinctive.

As indicated in Fig. 2, *C. molybdites* is apparently restricted to the southern part of California. It may possibly occur further north than present data indicates, especially in the Central Valley, since it has been reported from much more northerly latitudes elsewhere (Groves, 1962; Singer, 1948; 1962; Smith, 1954).

California material studied in the fresh condition appears to be *C. molybdites* var. *marginata* A. H. Smith, but the lamellae margins are white in the button stage rather than dark as indicated in the original description of the variety (Smith, 1949). However, the margins do darken to almost black as the carpophores mature.

The presence of clamp connections (fig. 3), also recently noted in

Arizona collections by C. Leathers (personal communication to H. D. Thiers), is of interest since Singer (1948; 1962), Smith (1949), and Smith (1954) all reported their absence. Preliminary anatomical examination of collections from other parts of the United States (Sundberg and H. D. Thiers, in preparation) has verified the presence of clamp connections in this species. This evidence indicates that they were probably overlooked by previous workers and their absence cannot be used, as had been by Singer (1948; 1962), in support of the generic segregation of *Chlorophyllum* from closely allied species of *Lepiota* sensu lato.

I wish to thank H. D. Thiers for guidance leading to and during this study and for his critical comments on the manuscript. The criticisms of K. Wells and G. Breckon were most appreciated. Financial support for field work was provided by the Department of Botany, University of California, Davis.

Note added in proof. Recently clamp connections were reported in *C. molybdites* from Tennessee and Israel (Heinemann, P. Bull. Jard. Bot. Etat 38:195-206. 1968) and from Africa and South America (Singer, R. Beih. Nova Hedwigia 29:1-405. 1969).

#### LITERATURE CITED

- GROVES, J. W. 1962. Edible and poisonous mushrooms of Canada. Queen's Printer, Ottawa.
- RIDGWAY, R. 1912. Color standards and color nomenclature. Washington, D. C.
- SINGER, R. 1948. New and interesting species of basidiomycetes. II. Pap. Michigan Acad. Sci. 32:103-150.
- . 1962. The Agaricales in modern taxonomy. 2nd ed. J. Cramer, Weinheim.
- SMITH, A. H. 1949. Mushrooms in their natural habitats. Sawyers, Portland.
- SMITH, C. O. 1936. *Lepiota morgani* in Southern California. Mycologia 28:86.
- SMITH, H. 1954. A revision of the Michigan species of *Lepiota*. Lloydia 17:307-328.
- SUNDBERG, W. J. 1967. The family Lepiotaceae in California. Master's thesis. San Francisco State College.

### POLYPHYLETIC ORIGIN OF TETRAPLOID POPULATIONS OF GUTIERREZIA SAROTHRÆ (COMPOSITÆ)

OTTO T. SOLBRIG

Gray Herbarium, Harvard University, Cambridge, Massachusetts 02138

The widespread western North American species *Gutierrezia sarothrae* (Compositae—Astereae) possesses two chromosomal races: a diploid ( $n = 4$ ) race that is the most common, and a less common tetraploid ( $n = 8$ ) race, that comprises approximately 20% of populations. Both races are morphologically very similar. Although the polyploids tend to have statistically slightly larger pollen and stomata, there is no single character by which the two races can be separated (Solbrig, 1964). This is due to a great deal of variability in both the diploid and tetraploid forms. Neither can the two races be separated on the basis of geographical distribution since the tetraploid populations occur interspersed throughout the distribution of the species.